Volume 9

1967-1968

STATE OF ALASKA
Walter J. Hickel, Governor

ANNUAL REPORT OF PROGRESS, 1967 - 1968

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-9

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
Augie Reetz, Commissioner

Alex H. McRea, Director
Division of Sport Fish

Louis S. Bandirola, Coordinator

INTRODUCTION

This report of progress consists of findings and work accomplished under the State of Alaska Federal Aid in Fish Restoration Project F-5-R-9, "Sport Fish Investigations of Alaska."

The project during this reporting period was composed of 21 separate studies. Of these, seven jobs continued the inventorying and cataloging of the numerous waters, providing a comprehensive index of the State's recreational waters. Nine jobs accomplished special studies involving Dolly Varden, grayling, silver salmon, king salmon and sheefish, among others. The remaining five jobs are designed to accomplish creel census, migration, access and silver salmon egg-take studies. The egg-take study, Job 7-F, was inactive because egg-takes were accomplished under other projects.

Special reports on specific phases of the Dolly Varden Life History Study have been published in the Department's Research Report series.

The information gathered from all of these studies provides the background necessary for better management and assists in development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

RESEARCH PROJECT SEGMENT

STATE: ALASKA

Name: Sport Fish Investigations of Alaska.

Project No.: F-5-R-9

Title: Inventory and Cataloging of the Sport Fish and Waters in the Kenai, Cook Inlet - Prince William Sound Areas.

Job No.: 7-A

Period Covered: July 1, 1967 to June 30, 1968.

ABSTRACT

A creel census on the Russian River during the flies-only season revealed an estimated harvest of 12,140 red salmon, Oncorhynchus nerka, during 16,470 man days of effort. The seasonal rate of success was 0.13 salmon per hour. A regulation prohibiting the retention of snagged fish reduced the catch by approximately 40 percent. The estimated escapement of 54,112 red salmon was the second largest recorded at the Russian River.

Arctic grayling, Thymallus arcticus, were introduced into four Kenai Peninsula waters in an attempt to establish self-sustaining populations. Resurrection Creek, Bench Lake, and Clear Lake received predominately age I+ grayling from Crescent Lake. South Fuller Lake was stocked with 25,000 hatchery-reared fry.

Growth rates were compared for transplanted red salmon smolts in five lakes. Mean lengths for age II+ red salmon ranged from 180.7 mm to 256.2 mm. Sexual maturity appeared to be related to accelerated growth.

Population sampling was conducted on three rehabilitated lakes to assess the growth and survival of rainbow trout, Salmo gairdneri. Fourteen months after being planted as fingerlings, the trout had achieved averaged lengths ranging from 286.4 mm to 300.9 mm.

Cataloging and inventory activities were performed on 20 Kenai Peninsula lakes. Twelve of these waters contained game fish with rainbow trout and Dolly Varden, Salvelinus malma, the most common species. Gill net catch data are presented.

Difference in adipose fin pigmentation was found to be a valid characteristic for separating juvenile king, Oncorhynchus tshawytscha, and silver salmon, Oncorhynchus kisutch, in the Kenai River drainage. Smolt collections from the Kenai River revealed that 90 percent of the silver salmon were age II and 96 percent of the kings were Age I. Age-length relationships are described for both species.

Six hundred eighty-three adult silver salmon were enumerated at the Swanson River weir from August 21 through September 8. Information is presented on the sex composition and length frequency of the run. Age group 2.1 dominated the migration.

The depth distribution of Arctic char, Salvelinus alpinus, was studied with vertical gill nets at East Finger Lake from July 1 through October 25. As the season progressed and the surface waters cooled, the average depth

of capture decreased. Preliminary observations suggest that surface temperatures in excess of 55° F. tend to restrict Arctic char to mid-water (20 to 30 feet) or bottom depths (35 to 45 feet). More than 89 percent of the char were taken in water temperatures below 55° F.

RECOMMENDATIONS

Retain present objectives of the study with emphasis directed toward the following:

1. Continue the Russian River creel census to determine the effects of an anti-snagging regulation on red salmon.

2. Develop a sampling program to determine the age structure of the Kenai River king and silver salmon smolt migrations.

3. Continue measuring the vertical distribution of Arctic char in East Finger Lake.

4. Evaluate past Arctic grayling transplants and investigate additional waters for the establishment of the species.

5. Continue evaluation of currently stocked lakes and stocking policies.

6. Compile and analyze all rainbow trout age and growth data from Gruski Lake.

OBJECTIVES

1. To assess the environmental characteristics of existing and potential recreational fishery waters of the job area; to obtain estimates of existing and/or potential use and sport fish harvest; and to determine spatial distribution of game fishes in selected waters.

2. To evaluate application of fishery restoration measures and availability of sport fish egg sources.

3. To assist as required in the investigation of public access status to the area's fishing waters and to make specific recommendations for segregation of public fishing access sites.

4. To evaluate multiple water-use development projects (public and private) and their effects on the area's streams and lakes for the proper protection of the sport fish resources.

5. To provide recommendations for the management of the sport fish resources in these waters and direct the course of future studies.

TECHNIQUES USED

The Russian River creel census was a modification of the method described by Neuhold and Lu (1957). Sampling procedures were identical to those outlined by Engel (1964), except that fishermen counts were increased to include four of the five weekdays.

Arctic grayling were collected with a 50-foot beach seine and by hook and line at the outlet of Crescent Lake. Fish were placed in holding pens

in the lake prior to being transported by aircraft in polyethylene bags containing about five gallons of water. Each bag was filled two-thirds with water and fish, then inflated with oxygen and sealed. Depending on their size, up to 50 grayling were carried in each bag.

Grayling fry, from the Fire Lake Hatchery, were flown to South Fuller Lake in polyethylene bags containing water and oxygen. The fish were aerial dropped from an altitude of 50 feet after the bags were slashed open.

Standard lake survey methods were used to collect physical and chemical data. Monofilament gill nets (125 x 6-foot) having five mesh sizes ranging from 3/4- to 2-inch bar measure were used to determine the fish species present, relative abundance, and to obtain age and growth information. Multifilament gill nets (100 x 6-foot) having five mesh sizes ranging from 1/2- to 1 1/4-inch bar measure were employed with monofilament nets to capture rainbow trout at Gruski Lake and to evaluate red salmon transplants. A portable P-100 Ross depth finder was utilized to measure depths.

Grayling, king salmon, and silver salmon smolt scales were mounted on glass slides and examined by microprojector for age determinations. Cellulose-acetate scale impressions were used to assign ages to adult silver salmon from the Swanson River.

A temporary weir was erected across the Swanson River to capture silver salmon. A detailed description of the weir and its operation has been presented by Engel (1966).

Depth distribution was determined for Arctic char by suspending gill nets from the surface to the lake bottom. Nets of a similar design have been described by Horak and Tanner (1964) who used vertical gill nets in the Horsetooth Reservoir, Colorado. Each net was wound around a sealed section of 4-inch aluminum pipe 8 feet long. Aluminum axles were welded on each end of the sealed pipe to aid in setting and rewinding. The aluminum pipe served as a roller-float from which the nets were unwound until the lower end reached the lake bottom.

The nets were set in the following manner: A roller-float, with net wrapped around it, was placed in a cradle mounted on the side of the boat. A spreader bar, 70 inches in length, of 1/2-inch thin-walled aluminum conduit with snaps at each end, was fastened to the bottom of the net. Three-pound weights were fastened to each end of conduit. The net was then unrolled and pulled toward the bottom by the spreader bar and weights. Additional spreader bars were attached to the net at 30-foot intervals. After the net had reached the bottom, the netting on the roller-floats was secured with snaps to prevent further unrolling. One end of the roller-float was then fastened to an anchored buoy and the other end to the next float in the net series. The last roller-float in the series was also attached to an anchored buoy. Fish were removed as the net was wound back on the roller-float. The depth of capture was determined by color coding on the net side lines.

The 150 x 6-foot nets were constructed of monofilament and had 1/2-inch polyethylene side lines. Metal rings, 1 1/4-inch in diameter, were tied to the side lines every 30 feet to permit attachment of the spreader bars. Mesh sizes in inches were: 1/2, 3/4, 1, 1 1/4 and 1 3/4 bar measure.

Two vertical gill net series, each consisting of five nets, with the above mesh sizes, were permanently established. All nets were lifted and reset on a weekly basis. A temperature profile was obtained at each station after the nets were reset. Water samples for dissolved oxygen, pH and alkalinity were collected monthly at 10-foot intervals.

FINDINGS

Russian River Creel Census

In recent years the Russian River red salmon run has developed into one of Alaska's most popular and controversial sport fisheries. The polemic features of the fishery stem from snagging, a common angling practice since the inception of the fishery. The stream's management program has been influenced to an important degree by public expression regarding the unethical aspects of snagging. Past management practices at the Russian River have been discussed by Lawler (1963) and Engel (1966a).

The Board of Fish and Game, in December of 1966, adopted an anti-snagging regulation in an attempt to establish a more acceptable method of harvest. The new regulation required that any fish hooked elsewhere than in the mouth, head, or gills, must be immediately released. Only unweighted, single hook flies with gap between point and shank of 3/8-inch or less were permitted. Weights were allowed if they preceded the fly by 18 inches or more.

To evaluate the effects of these regulations, the creel census initiated in 1962 was continued during this report segment. The census was active from June 10 through August 15 and sampled nearly the entire fishing effort on red salmon. The 37 weekday and 42 weekend counts during this period averaged 56.8 and 87.9 anglers, respectively. Projected fishermen counts yielded estimates of 16,470 man-days of effort or a total of 89,145 angler hours. Anglers fished an average of 5.3 hours on weekdays and 5.6 hours on weekend days. The total catch, based on interviews with 7,660 anglers, was estimated to be 12,140 red salmon. The mean rate of success was 0.13 fish per hour. Table 1 summarizes harvest, fishing effort and rate of success since 1962.

The regulation prohibiting the retention of foul-hooked fish reduced intentional snagging and the total yield to the creel. An estimated 8,260 red salmon (40.5 percent of total landed) were reported released because they were foul-hooked. Insufficient data concerning possible hook and release mortality do not permit a complete evaluation of the regulation. However, retaining the foul-hooked fish would not appear to have been detrimental to the escapement.

TABLE 1 - Red Salmon Sport Harvest, Effort, and Rate of Success on the Russian River, 1962 - 1967.

Year	Sport Harvest	Effort (man-days)	Catch Per Hour	Census Period
1962	4,700	6,595	0.22	6/15 - 8/12
1963	5,060	7,880	0.19	6/8 - 8/15
1964	6,855	4,940*	0.31	6/20 - 8/16
1965	10,700	8,320	0.25	6/15 - 8/15
1966	21,820	17,890	0.21	6/15 - 8/15
1967	12,140**	16,470	0.13	6/10 - 8/15

*Damage to the Seward Highway by the March 27 earthquake resulted in reduced effort.

**Approximately 8,260 additional salmon were reported released because of the foul hook law.

Substantial public opposition to the foul-hook regulation was evident at the beginning of the season. Since dissatisfied sportsmen probably are more likely to protest voluntarily than are satisfied anglers, a survey was conducted to randomly assess public opinion regarding the foul-hook regulation. Of the 1,233 anglers that were polled between June 23 and August 15, 50.6 percent favored and 41.4 percent opposed the anti-snagging law. Eight percent of the fishermen offered no opinion. Table 2 summarizes the rate of success and the rate of release for the fishermen questioned. In general, anglers that favored the regulation retained and released the most salmon. Answers to the principal questions in the survey were frequently supplemented with the following remarks: (1) seasons and bag limits should be used to manage the resource; (2) salmon that are unintentionally snagged should be retained; (3) barbless hooks should be required to reduce hook and release mortality.

TABLE 2 - Russian River Fishermen Opinions on Anti-Snagging Regulations, 1967.

Opinion	No. Anglers	Percent	Fish Retained Per Angler	Fish Released Per Angler
Favor	624	50.6	0.62	0.47
Opposed	511	41.4	0.55	0.38
Indifferent	98	8.0	0.28	0.13

A counting tower at the outlet of Lower Russian Lake provides an assessment of the escapement after the Russian River red salmon run has been harvested by the Cook Inlet commercial and Russian River sport fisheries. Since 1960, escapements past the tower have averaged 44,107 with a maximum estimate of 56,960 red salmon in 1963. In 1967 escapement of 54,112 was exceeded only by the 1963 run. Based on the sport catch of 12,140 red salmon and a tower count of 54,112, the run to the stream in 1967 was the largest on record.

The bimodal nature of the 1967 red salmon run was consistent with past escapement patterns. The early migration arrived at the stream on June 8 and had passed through the sport fishery by early July. The second run entered the stream about July 18 and was nearly complete by August 15.

The importance of the early run, which contributed approximately 70 percent of the seasonal catch, was again evident in 1967. An estimated 41.9 percent of the early run was harvested by the sport fishery. This percentage would have been considerably greater if foul-hooked salmon (an estimated 5,800) had been kept. During recent years, the sport fishery has harvested as high as 53 percent of the early migration (Table 3).

TABLE 3 - Russian River Red Salmon Catch Distribution and Tower Counts For Past Years.

Year	Total Escapement	Early Run* Escapement	Est. Early Run Catch	Total Early Run	Percent of Early Run Caught
1960	37,680	7,807	----	----	----
1961	22,804	6,712	----	----	----
1962	48,214	28,980	3,408	32,388	10.5
1963	56,960	13,136	3,670	16,806	21.8
1964	52,052	12,260	4,970	17,230	28.8

TABLE 3 (Con't) - Russian River Red Salmon Catch Distribution and Tower Counts for Past Years.

Year	Total Escapement	Early Run* Escapement	Est. Early Run Catch	Total Early Run	Percent of Early Run Caught
1965	37,152	18,440	7,758	26,198	29.6
1966	43,880	14,280	16,365	30,645	53.4
1967	54,112	11,768	8,497	20,265	41.9

*July 15 was used as the termination date for the early run.

Grayling Transplants

Arctic grayling were first brought to the Kenai Peninsula in 1952 and introduced into Crescent Lake. A substantial, self-sustaining population developed rapidly from the original plant of 240 adults. Since 1962, Crescent Lake grayling have been transplanted to several lakes and streams on the Kenai Peninsula (Table 4).

TABLE 4 - Waters Stocked on the Kenai Peninsula with Crescent Lake Grayling, 1962 - 1966.

Name	Year	Number of Fish
Jerome Lake	1962	283*
Upper Paradise Lake	1962	242**
	1963	165
Vagt Lake	1963	49
	1965	170
Carter Lake	1963	105
Grayling Lake	1964	154
	1965	151
Twin Lake	1965	176
	1966	97
Devil's Pass Lake	1965	113
Juneau Lake	1964	100
	1966	313
Upper Granite Creek	1965	378
	1966	347
Primrose Creek	1966	50

*Mortality estimated at 26 percent.
**Mortality estimated at 27 percent.

During this report segment, three experimental transplants were made with grayling from Crescent Lake and one lake received grayling fry from the Fire Lake Hatchery. All waters selected for introductions are believed to have suitable spawning areas for self-sustaining populations.

With assistance from the U.S. Forest Service, a total of 705 grayling were seined at the outlet of Crescent Lake from August 2 to 8. Holding and transfer losses amounted to 28 fish. The maximum time in transit was 80 minutes. Fork lengths from 39 randomly selected fish ranged from 150 to 374 mm with a mean of 193.2 mm. Scale readings from these grayling suggested that the transplant was composed of 82 percent age I+, 10 percent age II+,

5 percent age III+, and 3 percent age IV+. Table 5 shows the numbers of fish and lakes where introductions were made.

TABLE 5 - Waters Stocked on the Kenai Peninsula with Grayling During 1967.

Name	Surface Acres	Number of Fish
Bench Lake	92	240
Clear Lake	95	175
South Fuller Lake	11	25,000 *
Resurrection Creek	--	262

*Fry originated from an egg take at Bessie Creek located near Tolsona Lake, Glennallen.

Red Salmon Transplants

Experimental red salmon transplants, utilizing smolts from Bear Lake, have been performed annually since 1965. The purpose of the plants has been twofold: first, to reduce competition between juvenile red and silver salmon in Bear Lake, which is being intensively managed as a silver salmon rearing area; and second, to establish game fish populations in several barren roadside lakes.

Smolts were captured at the Bear Creek weir during their seaward migration. The 1965 and 1966 transplants were predominately age I smolts that had mean fork lengths of 116.4 mm and 80.6 mm, respectively (Logan, 1966). The 1967 transplant was composed of 90.7 percent age II and 9.3 percent age I smolts that had a combined mean length of 99.1 mm (Logan, 1967). A hatchery tank truck was used to transport the smolts to the various study lakes. Table 6 shows numbers of fish and lakes where introductions were made.

TABLE 6 - Number of Red Salmon Smolts Stocked in Kenai Peninsula Lakes, 1965 - 1967.

Lake	Date Stocked	Fish Per Surface Acre	Total Fish Stocked
Sunken Island	June, 1966	224	31,350
	June, 1967	94	13,140
Portage	June, 1966	644	18,670
	June, 1967	378	10,950
Upper Jean	June, 1965	25	1,150
	June, 1966	754	34,670
	June, 1967	196	9,020
Rock	June, 1966	1,038	8,300
	June, 1967	1,279	10,230
Bernice	June, 1966	127	18,500
	June, 1967	152	22,160

TABLE 7 - Characteristics of Kenai Peninsula Lakes Stocked with Red Salmon.

Characteristics	Lake				
	Sunken Island	Portage	Upper Jean	Rock	Bernice
Surface area (acres)	140	29	46	8	146
Elevation (ft. above msl)	263	255	497	750	120
Maximum depth (ft.)	55	43	45	17	12
July water temperatures (° F.)					
Surface	61	62	62	63	62
Bottom at max. depth	40	42	48	55	61
Thermocline (July)	Yes	Yes	Yes	No	No
Depth (ft.)	15-27	15-24	25-33	—	—
April oxygen levels (ppm)*					
5 feet	7.3	7.2	6.4	—	3.4
10 feet	6.7	6.0	5.9	—	—
Color of water	Clear	Clear	Clear	Lt. brown	Lt. brown

*The period of ice-cover is normally from late October to early May.

An undetermined number of silver salmon smolts were inadvertently transplanted with the red salmon because of the simultaneous migration of the two species. Identification problems occurred primarily at night when weir attendants were required to rapidly separate and enumerate large numbers of fish.

The five lakes chosen for the transplants were selected because: (1) they have diverse physical and chemical characteristics which afford opportunities for comparative growth and survival studies, (2) they have negligible inlets or outlets which prevent seaward migration, and (3) they are located on public land that is accessible by road. Descriptions of the lakes are presented in Table 7. The physical characteristics of Upper Jean, Portage and Sunken Island Lakes are generally similar; all exceed 40 feet in depth and are thermally stratified during the summer. Bernice and Rock Lakes, both shallow, do not exhibit marked thermal stratification. Threespine sticklebacks, Gasterosteus aculeatus, are abundant in all lakes.

Each of the study lakes was sampled with gill nets during late September or early October to obtain comparative growth and survival rates. Red salmon growth in Sunken Island, Portage and Bernice Lakes was relatively slow. Upper Jean Lake produced moderate growth and Rock Lake the most rapid growth (Table 8). The exact reason for the faster growth of Rock Lake fish (heaviest stocking density) is incompletely known, but it may be related to an abundance of amphipods, Gammarus. Stomach contents of red salmon in the other study lakes revealed that sticklebacks and a variety of bottom organisms constituted a substantial portion of the diet. Zooplankton was a negligible food item.

TABLE 8 - Growth Comparisons and Relative Abundance of Transplanted Red and Silver Salmon in Kenai Peninsula Lakes.

	Species*	No. of Fish	Size Range (mm)	Mean Length (mm)	Catch Per Hour**
Sunken Island	RS	107	151-278	190.1	1.34
	SS	3	435-641	509.3	0.04
Portage	RS	13	153-211	180.7	0.20
	SS	13	156-554	279.3	0.20
Upper Jean	RS	26	164-285	223.9	0.27
	SS	15	187-529	433.4	0.17
Rock	RS	67	218-291	256.2	1.37
	SS	1	236	236.0	0.02
Bernice	RS	10	162-204	185.0	0.08

*Includes only fish from the 1966 transplant.
**Catch per net hour (125 x 6-foot and 100 x 6-foot variable mesh).

Sexual maturity appeared to be closely related to accelerated growth. The percentage of mature males, age II+, in the samples from Upper Jean and Rock Lakes, was 34 percent and 21 percent, respectively. Only one mature male was collected from the three lakes that produced slow growth. No

mature females were collected from any of the lakes. Only Upper Jean and Sunken Island Lakes appear to have beach spawning areas that may allow development of self-sustaining kokanee populations.

Table 8 shows strikingly different growth rates for red and silver salmon in common lake environments. The greater size of the silver salmon illustrates the species' superior ability to utilize and/or compete for available food. Maximum recorded weights for silver salmon in Sunken Island, Portage and Upper Jean Lakes were 7.75, 4.88 and 4.50 pounds, respectively. Stomach analyses indicate that the growth of the larger fish was accelerated by the consumption of red salmon.

Rainbow Trout Stocking Evaluations

Three rehabilitated lakes were sampled with gill nets to evaluate the success of the 1966 stocking program. Sport and Arc Lakes were rehabilitated in July, 1965 and Scout Lake in June, 1966. Rotenone was used to remove threespine sticklebacks from each lake. Physical and chemical characteristics of the lakes are presented in Table 9.

Sport and Arc Lakes, planted with 400 fingerlings per surface acre, yielded rainbow trout averaging 286.4 mm and 288.6 mm, respectively. Scout Lake, stocked with 285 fish per acre, produced trout that averaged 300.9 mm fork length. Gill net catches ranged from a low of 0.15 fish per hour in Scout Lake to a high of 0.40 fish per hour in Sport Lake. Stocking densities, growth and relative abundance of the planted rainbow trout are shown in Table 10.

Lake Surveys

Preliminary surveys were conducted on 20 lakes during this report period. Table 11 shows the location, surface acreage and maximum observed depth of these waters. Gill net sampling revealed game fish in 12 lakes, with rainbow trout and Dolly Varden, the most common species (Table 12). Longnose suckers, Catostomus catostomus and red and silver salmon were also present in some waters. Threespine sticklebacks were abundant in each of the lakes.

Kenai River Smolt Studies

The Kenai River system, with a drainage area of 1,860 square miles, is the largest salmon producer on the Kenai Peninsula. In order to estimate the magnitude of the system's red salmon smolt migration, four incline plane traps were placed in operation during the spring of 1967. The traps, operated by the Commercial Fisheries Division of the Alaska Department of Fish and Game, were located directly under the Sterling Highway Bridge at Soldotna.

At the start of the project it was evident that substantial numbers of silver and king salmon smolts were present with the migrant red salmon. Attempts to separate silver and king salmon by such external characteristics as spacing and shape of parr marks, shape of anal fin and fin ray coloration, proved unsatisfactory. To obtain a nearly positive means of external identification, 438 migrants (thought to be either king or silver salmon) were collected and preserved for further study. The specimens were periodically drawn from the migration between May 23 and June 18.

Observations by Meehan and Vania (1961) and Dalhberg and Phinney (1967) have indicated that the adipose fin of silver salmon in many Alaskan streams is completely pigmented, while those of king salmon display a clear area near the anterior fin base.

TABLE 9 - Physical and Chemical Characteristics of Kenai Peninsula Lakes Stocked with Rainbow Trout.

Lake	Surface Acres	Depth (ft.) Max.	Depth (ft.) Mean	M.O* Alkalinity (ppm)	pH*	Thermocline**	Aquatic Vegetation
Sport	71.7	20	10.9	43	6.3	No	Extensive
Scout	95.0	24	12.7	51	6.7	No	Limited
Arc	16.0	16	10.0	20	6.1	No	Limited

*Average of samples collected in April and May, 1967.
**Maximum summer surface temperatures range from 65° to 70° F.

TABLE 10 - Stocking Rates and Growth of Rainbow Trout in Kenai Peninsula Lakes.

Lake	Date Stocked	Trout/Acre	Fish/Lb.	Growth by October 1967 Length Range (mm)	Mean Length (mm)	Mean Weight (lb.)	Catch/Hour*
Sport	7/66	400	1,160	240-318	286.4	0.64	0.40
Scout	8/66	285	325	260-331	300.9	0.83	0.15
Arc	7/66	400	1,160	269-312	288.6	0.67	0.27

*Catch per net hour - 125 x 6-foot variable mesh.

TABLE 11 - Location, Surface Acreage and Maximum Depth of Lakes Surveyed on the Kenai Peninsula During 1967.

Name of Lake	Surface Acres*	Maximum Observed Depth (Ft.)	Location	
Beaver	425	15	T 8N., R10W., Sec.	25-26 36
Caribou	720	33	T 3S., R10W., Sec.	19-20 24
Plover	90	6	T 7N., R10W., Sec.	4
Akula	177	9	T 7N., R10W., Sec.	21
Quill	185	19	T 8N., R 8W., Sec.	19-30
Ski	9	22	T 2N., R 1W., Sec.	24
Hazel	230	--	T 8S., R11W., Sec.	18
Tern	75	11	T 7N., R10W., Sec.	16-17 20-21
Pintail	80	9	T 8N., R 8W., Sec.	30
Trapper	35	14	T 7N., R10W., Sec.	15
Carmen	640	50+	T10N., R 4E., Sec.	32-33
Sunrise	5	10	T 9N., R 1W., Sec.	10
Killdeer	70	14	T 7N., R10W., Sec.	9-10
Little Heart	35	15	T 7N., R10W., Sec.	16
Ootka	182	12	T 7N., R10W., Sec.	16-17
Lucerne	40	11	T 7N., R10W., Sec.	9
Shadura	235	12	T 7N., R10W., Sec.	15
Turhune	14	29	T 7N., R 9W., Sec.	32-33
Loon	73	168	T 5S., R10W., Sec.	29
Clear	95	158	T 6S., R11W., Sec.	25

*Acreages were determined by map grids from U.S.G.S. maps, (1:63,360).

TABLE 12 - Gill Net Results for Lakes Surveyed on the Kenai Peninsula During 1967.

Name of Lake	Species	Number of Fish	Length Range (mm)	Mean Length (mm)	Catch Per** Hour
Beaver	SK	134	138 - 462	393	1.97
	RB	96	140 - 468	292	1.41
	SS	2	130 - 134	132	0.03
Caribou	DV	56	223 - 394	320	1.08
	RS	1	142	142	0.02
Plover	RB	35	153 - 452	317	0.74
	SS	7	140 - 329	225	0.15
Akula	RB	12	150 - 503	252	0.68
	SS	3	237 - 361	304	0.17
Quill	RB	21	148 - 420	309	0.51
Ski	DV	24	115 - 250	154	0.51
Hazel	DV	12	162 - 188	174	0.50
Tern	RB	13	193 - 562	326	0.33
Pintail	RB	9	289 - 451	374	0.20
Trapper	RB	2	212 - 362	287	0.10
Carmen	DV	4	183 - 270	244	0.09
Sunrise	DV	1	202	202	0.02
Killdeer	No Fish Taken				
Little Heart	No Fish Taken				
Ootka	No Fish Taken				
Lucerne	No Fish Taken				
Shadura	No Fish Taken				
Turhune	No Fish Taken				
Loon	No Fish Taken				
Clear	No Fish Taken				

*Key: RB - Rainbow Trout
DV - Dolly Varden
SS - Silver Salmon
SK - Longnose Sucker
RS - Red Salmon

**Catch/Net Hour - 125 x 6-Foot Variable Mesh

To test the validity of this characteristic for Kenai River smolts, 25 silver and 25 king salmon were randomly selected and identified on the basis of pigmentation of the adipose fin. Pyloric caeca counts revealed that all 50 fish were identified correctly. The remaining specimens were then separated solely on the differences in adipose pigmentation.

If the preserved samples are representative of the population from which they were collected, then it appears length may be useful in distinguishing the two species. Length-frequency data reveal that 98.7 percent of the king salmon were less than 100 mm in fork length, whereas 92.8 percent of the silver salmon exceeded 100 mm. A working hypothesis to separate by size was not developed because of possible sampling selectivity. However, available data indicate the need for a carefully planned sampling program to explore the possibility of separating the two species by size.

Age-length relationships for silver and king salmon smolts are presented in Figure 1. Approximately 90 percent of the silver salmon were age II with a modal length between 125 and 130 mm. Age III smolts, ranging from 136 to 172 mm, comprised 6 percent of the sample and age I fish, ranging from 50-65 mm, made up the remainder of the catch. The brown coloration and distinct parr marks of the yearling fish suggest that they were not seaward migrants.

The king salmon sample was composed of 1.7 percent young-of-the-year, 96.0 percent age I and 2.3 percent age II smolts. Age I migrants ranged from 5.1 to 98 mm fork length and had a mode between 70-75 mm. The zero age group measured from 35 to 44 mm and the age II fish ranged from 95 to 113 mm.

Silver Salmon Egg Take Investigation

A temporary weir was again erected across the Swanson River to evaluate the stream's potential as a silver salmon egg take source. Specific objectives of the investigation were: (1) to obtain spawn if other Alaska egg takes failed, (2) to assess the effect of the 1963 egg take on returning adults, and (3) to collect data on the biological characteristics of the stock. Results of prior studies are showing that Swanson River silver salmon are not particularly desirable for artificial propagation because the race matures at a relatively small size and also that the run is receiving greater utilization by sport fishermen. A summary of past information collected at the Swanson River has been presented by Engel (1966).

The Swanson River weir operated from August 21 until an alternative supply of silver salmon eggs was assured on September 8. During this period 683 salmon, 6 red salmon and 1 king salmon were enumerated and passed upstream. Although the short period of weir operation may not provide a reliable comparison with past migrations, the data suggest that an above a average run was in progress. A total of 197 silver salmon passed the weir from August 29 through September 8,1963, the parent year, whereas, 359 fish were enumerated within the same period in 1967. The 1963-1966 average for this interval was 217 silver salmon. Table 13 shows silver salmon counts at the Swanson River since 1962.

Based on scale readings from 122 fish, the age structure of the run was probably as follows: age group 2.1, 93 percent; age group 1.1, 4 percent; age group 3.1, 2 percent; and age group 2.0, 1 percent. Length-frequency distributions for both sexes are shown in Figure 2. Mean fork lengths for males and females were 60.4 and 62.6 cm, respectively. The sex ratio was 1 female to 1.2 males.

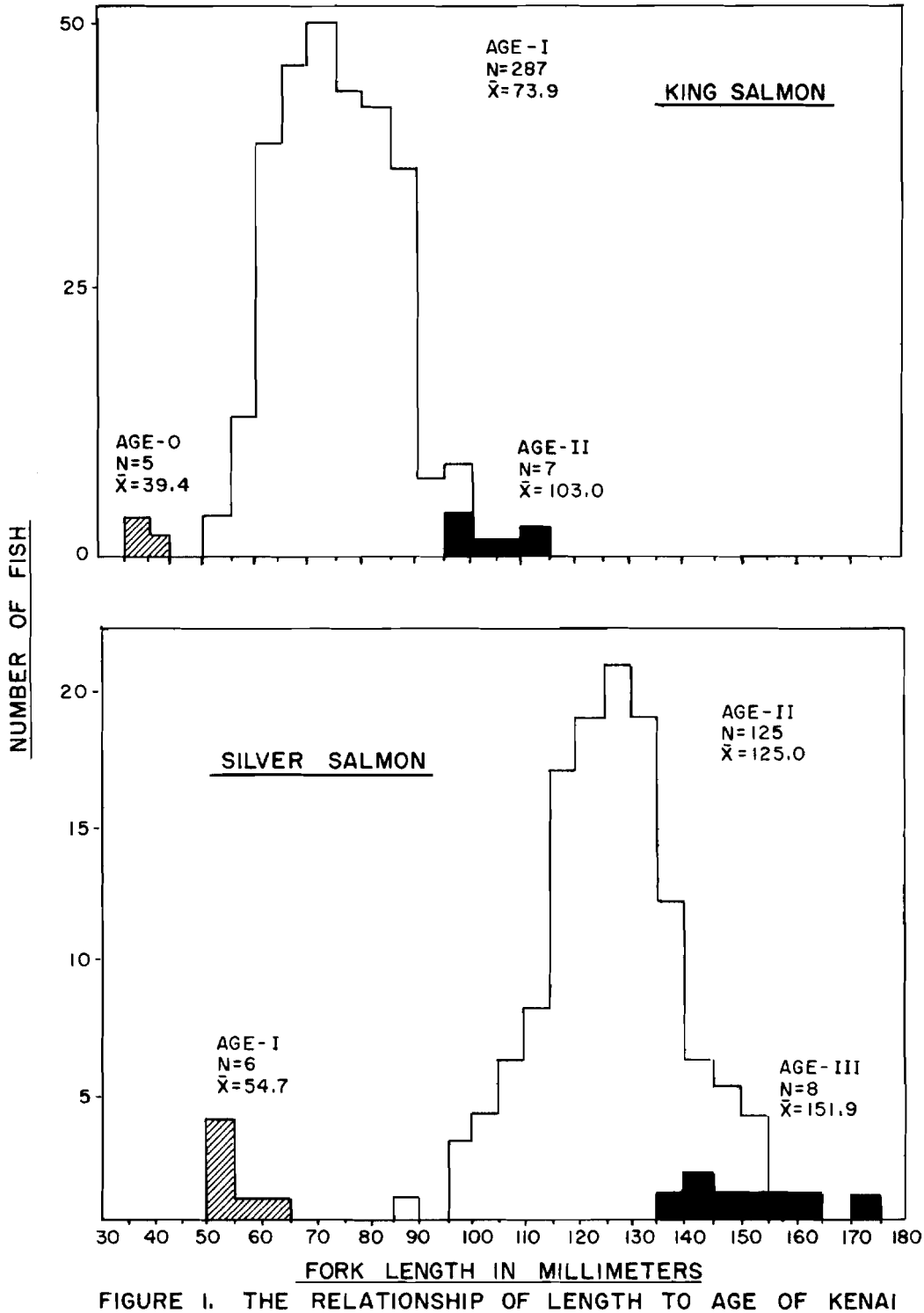

FIGURE 1. THE RELATIONSHIP OF LENGTH TO AGE OF KENAI RIVER KING AND SILVER SALMON SMOLTS, 1967.

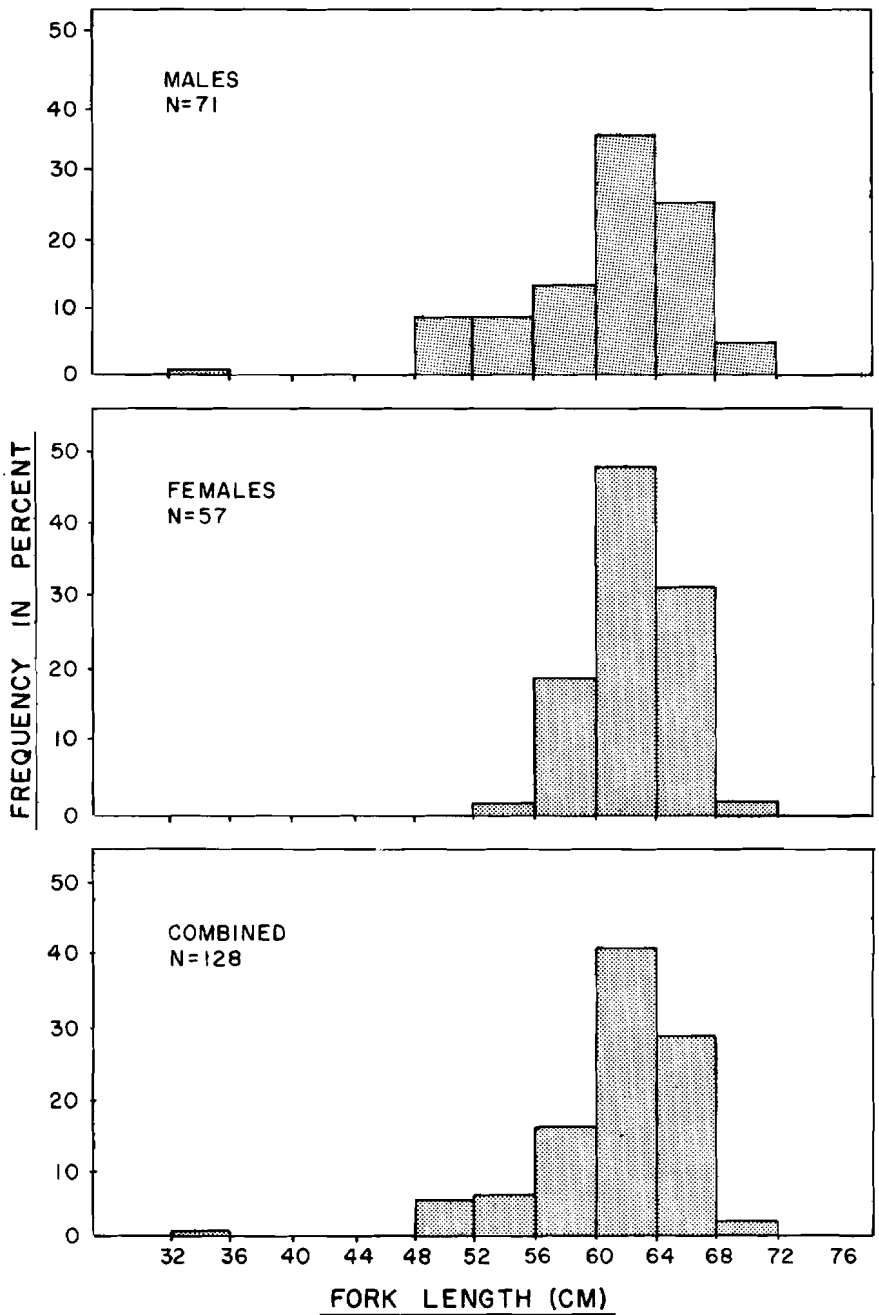

FIGURE 2. LENGTH FREQUENCIES OF MALE AND FEMALE SILVER SALMON AT SWANSON RIVER, 1967.

TABLE 13 - Swanson River Silver Salmon Counts by Sex, 1962-1967.

Year	Total	Males	Females	Period of Weir Operation
1962	239	74	165	9/22 to 10/25
1963	1,198	570	628	8/29 to 10/27
1964	1,185*	470	587	8/21 to 10/18
1965	2,043	1,022	1,021	8/19 to 10/12**
1966	553	264	289	8/26 to 10/20
1967	683	374	309	8/21 to 9/8

*Total includes 128 unsexed fish.
**The stream exceeded the height of the weir on 9/19 and remained at that level until the structure was removed.

Preliminary Observations on the Vertical Distribution of Arctic Char

An understanding of the factors that influence seasonal variation in the verticial distribution of Arctic char is essential to the management of the species. Creel census studies on Kenai Peninsula lakes have shown that Arctic char are relatively unimportant to the summer sport fishery, whereas the species contributes substantially to the harvest during the winter, spring and fall. On the basis of limited gill net sampling, it was postulated that char occupy deep water in summer and therefore are not vulnerable to capture by conventional fishing techniques.

This report segment describes the initial results of a study to determine the vertical distribution of Arctic char in East Finger Lake, located in the westcentral lowlands of the Kenai Peninsula. The investigation commenced July 1 and continued until the first formation of ice on October 25. Since spring and early summer data are lacking, the available information should be viewed with caution. A detailed analysis of the depth-distribution of Arctic char will be presented after the conclusion of the study in 1968.

East Finger Lake is approximately 70 acres in size and has a maximum depth of 47 feet. The lake has no permanent inlets, but drains by an outlet stream to Middle Finger Lake. Surface temperatures during the study varied from 40° to 74° F. The lake was thermally stratified from July through September. The epilimnion extended to 15, 19, and 27 feet during July, August, and September, respectively. The 50-degree isotherm sank from 14 feet on July 1 to 24 feet on August 29, then gradually rose until the surface waters cooled to 50° F. in late September (Figure 3). The lake was a homothermus 40° F. on October 25. Dissolved oxygen remained above 5 ppm at all depths. The average pH ranged from 6.9 at the surface to 6.6 at the bottom. The mean level of methyl orange alkalinity, which varied only slightly with depth, was 68 ppm.

Two vertical gill net stations were permanently selected for study. Station 1, located at the north end of the lake, was 45 feet deep and Station 2, at the south end of the lake, was 44 feet deep. Both stations were within 200 feet of shore.

Two hundred forty-one Arctic char, ranging from 132 to 377 mm, with a mean of 293.9 mm, were netted during the study. Sixty-three percent of the catch was taken at Station 1. Since capture depths were fairly consistent at both locations, the samples were combined for analysis. Temperature profiles were nearly identical at both stations throughout the investigation.

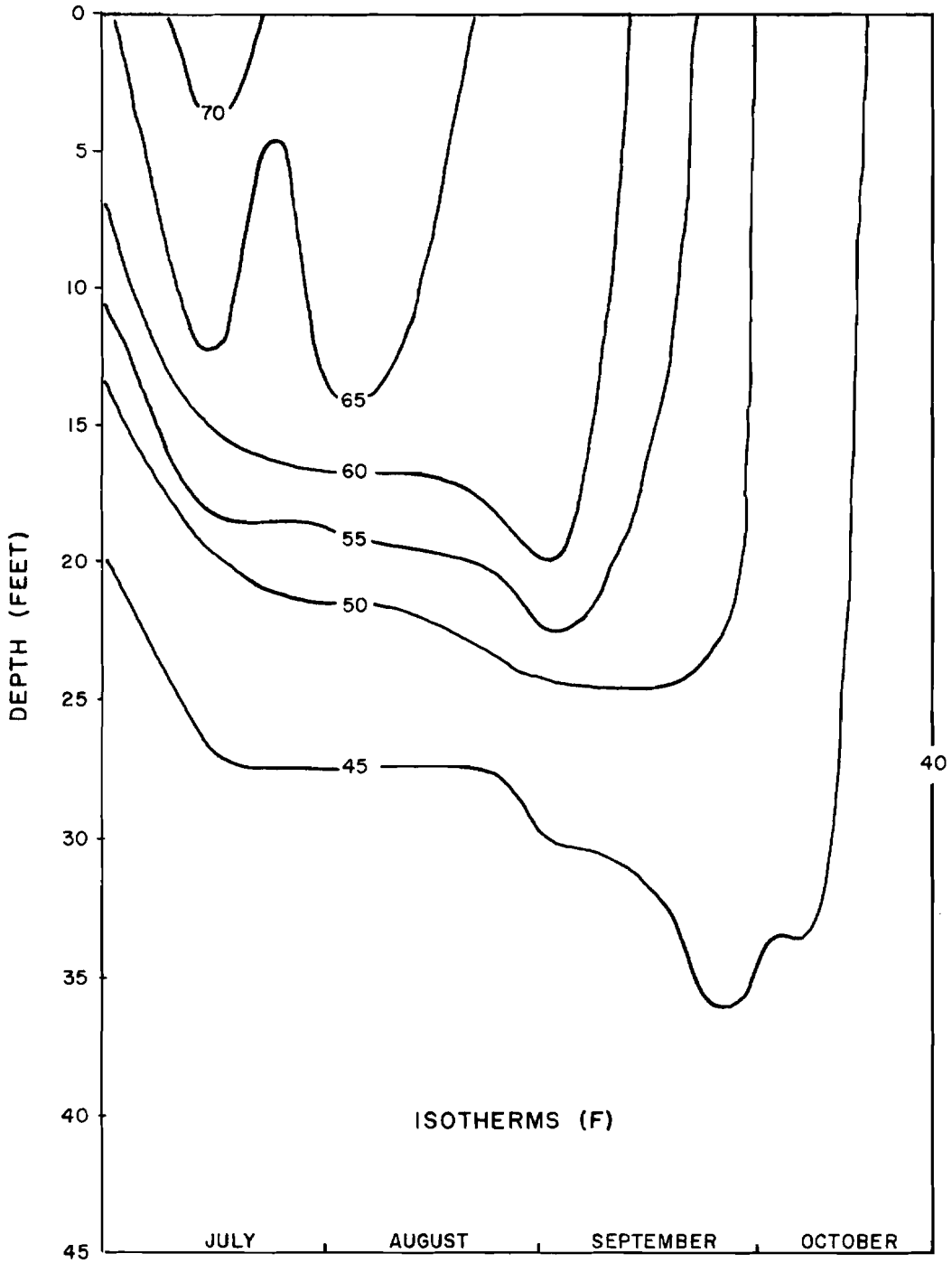

FIGURE 3. TEMPERATURE ISOTHERMS AT STATION I ON EAST FINGER LAKE, 1967.

July sampling showed a significant increase in catch with increasing depth. As the season progressed and the upper waters cooled, the average depth of capture decreased (Figures 4 and 5). The catch of Arctic char near the surface in October was considerably greater than during July. The average depths of capture in July, August, September and October were 32.4, 24.9, 19.6 and 17.3 feet, respectively.

Water temperature appears to be the factor that exerts the most influence on the depth-distribution of Arctic char. Char were captured in water temperatures varying from 40° to 60° F. However, more than 89 percent were taken in water colder than 55° F. During July and August, 70 percent of the char were captured in water that ranged from 41° to 50° F. These data suggest that surface temperatures in excess of 55° F. tend to restrict Arctic char to mid-water (20-30 feet) or bottom depths (35-45 feet).

Since depth-distribution patterns for zooplankton were not measured, it was not possible to determine the effect of this environmental factor on char behavior. Prior studies have shown a high utilization of cladocerans by juvenile Arctic char in East Finger Lake.

A total of 21 longnose suckers, ranging from 154 to 227 mm, was also captured during the study. Depth-distribution patterns are not presented because of the small sample size.

Rainbow Trout Age and Growth Studies

The field collection phase of an age and growth study of rainbow trout from Gruski Lake was completed during this report segment. A total of 1,070 rainbow trout was obtained by gill net between February, 1967 and January, 1968. Samples were collected monthly except during May and November when ice conditions were hazardous. All scales have been pressed on 0.02-inch-thick cellulose acetate and a detailed analysis is now in progress.

The mean fork length and weight of male trout were 245.2 mm and 0.44 pounds, respectively. Males ranged from 105 mm to 460 mm. Females average 273.8 mm in length and 0.60 pounds in weight, and ranged from 117 mm to 438 mm. Males dominated the sample at a 1.2:1 ratio.

Complete records of all cataloging and inventory activities during this job segment are on file at the Soldotna office of the Alaska Department of Fish and Game.

LITERATURE CITED

Dalhberg, M.L., and D.E. Phinney. 1967. The Use of Adipose Fin Pigmentation for Distinguishing between Juvenile Chinook and Coho Salmon in Alaska. Journal Fisheries Research Board, Canada, Volume 24 (1), pp. 209-210.

Engel, Larry J. 1964. Inventory and Cataloging of the Sport Fish and Sport Fish Waters on the Kenai Peninsula, Cook Inlet-Prince William Sound Areas. Alaska Department of Fish and Game, Annual Report of Progress, 1964-1965, Volume 6, pp. 111-127.

_____. 1966. Egg Take Investigation in Cook Inlet Drainage and Prince William Sound. Alaska Department of Fish and Game, Annual Report of Progress, 1966-1967, Volume 8.

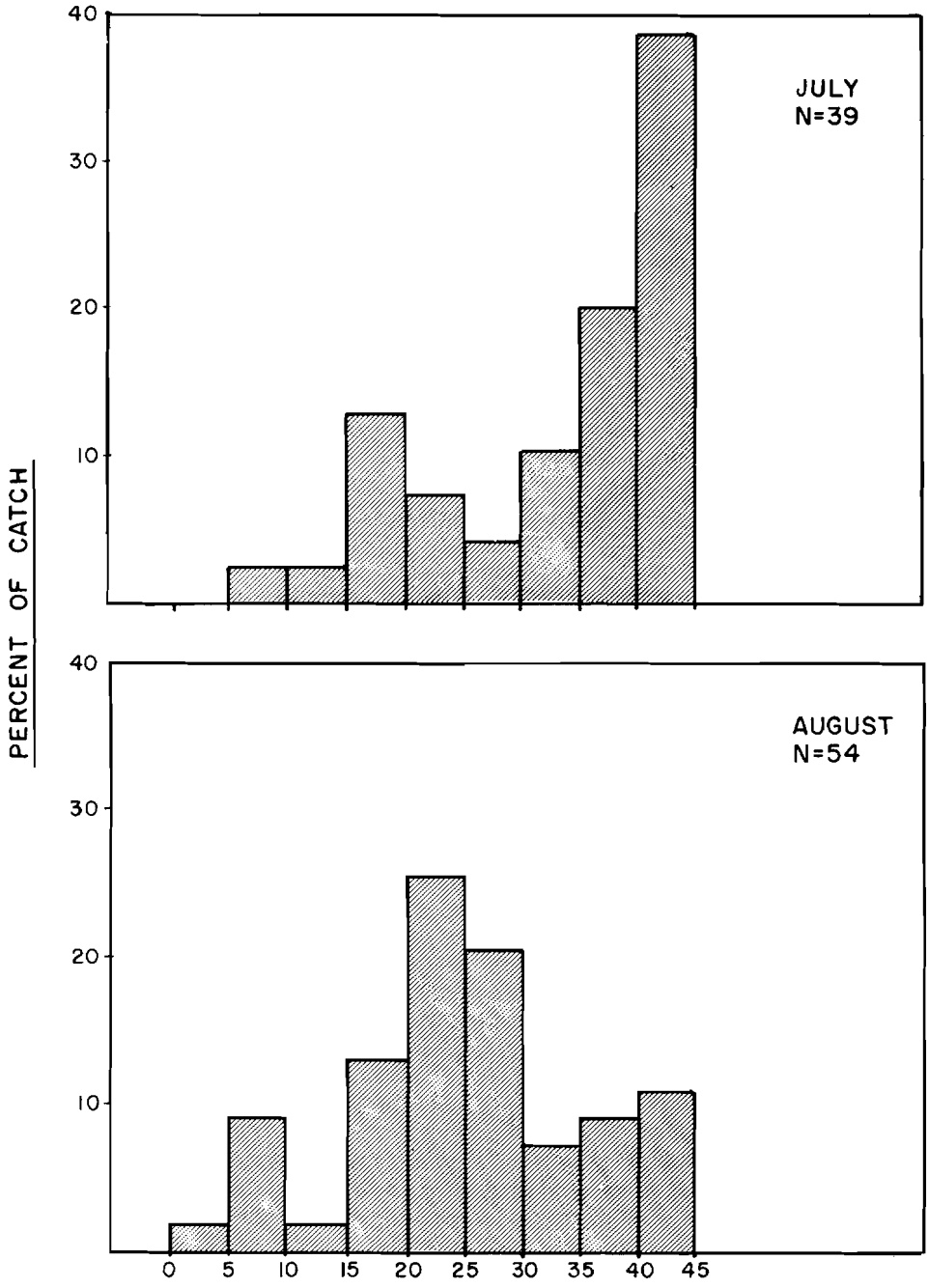

FIGURE 4. THE PERCENT OF ARCTIC CHAR CAPTURED AT VARIOUS DEPTHS IN EAST FINGER LAKE DURING JULY AND AUGUST, 1967.

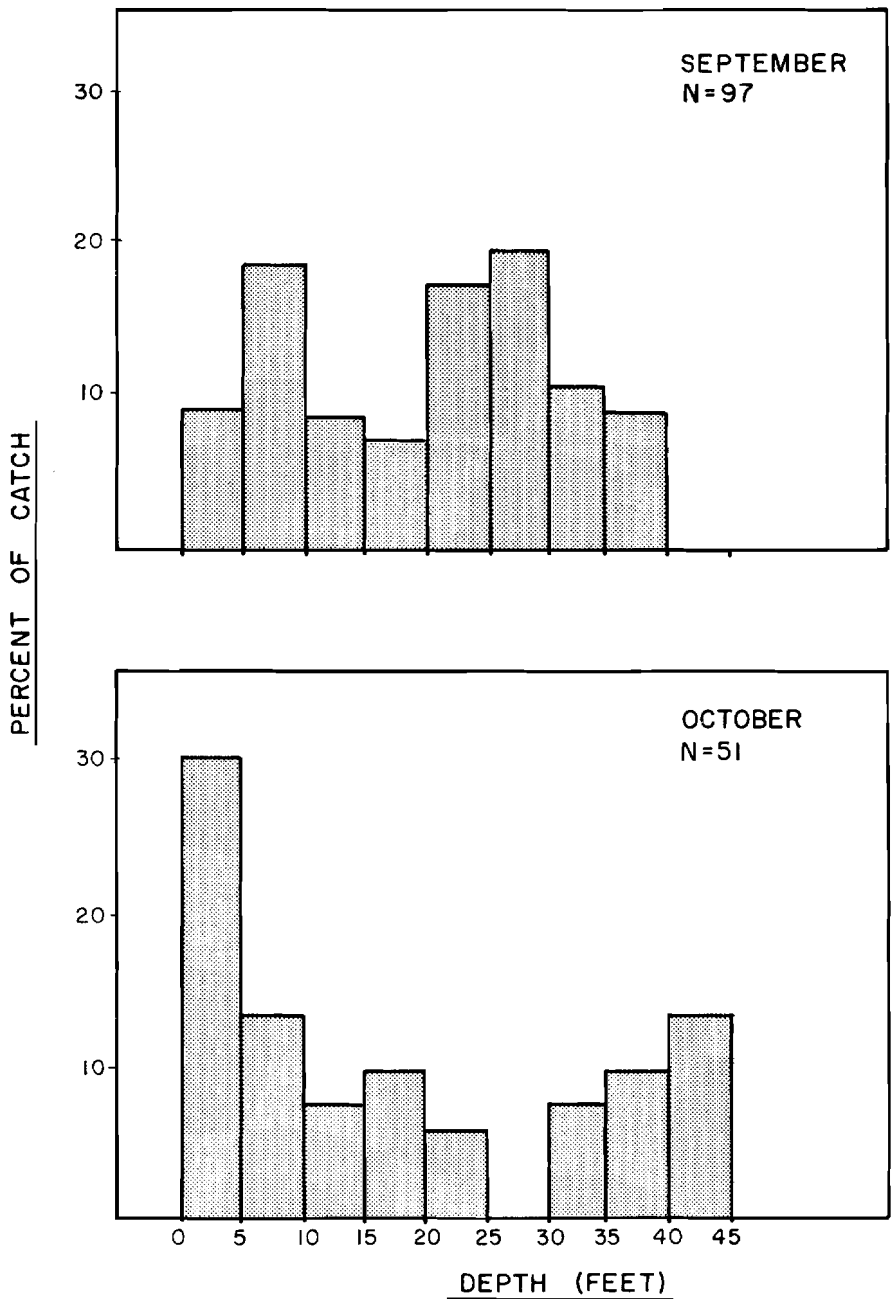

FIGURE 5. THE PERCENT OF ARCTIC CHAR CAPTURED AT VARIOUS DEPTHS IN EAST FINGER LAKE DURING SEPTEMBER AND OCTOBER, 1967.

_____. 1966a. Inventory and Cataloging of the Sport Fish and Its Waters on the Kenai, Cook Inlet-Prince William Sound Areas. Alaska Department of Fish and Game, Annual Report of Progress, 1966-1967, Volume 8.

Horak, D.L., and H.A. Tanner. 1964. The Use of Vertical Gill Nets in Studying Depth Distribution, Horsetooth Reservoir, Colorado. Transactions of the American Fisheries Society, Volume 93 (2), pp. 137-145.

Lawler, Robert R. 1962. Inventory and Cataloging of the Sport Fish and Sport Fish Waters on the Kenai Peninsula, Cook Inlet-Prince William Sound Areas. Alaska Department of Fish and Game, Annual Report of Progress, 1962-1963, Volume 4, pp. 145-160.

Logan, Sidney M. 1966. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game, Annual Report of Progress, 1966-1967, Volume 8.

_____. 1967. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game, Annual Report of Progress, 1967-1968, Volume 9.

Meehan, W.R., and J.S. Vania. 1961. An External Characteristic to Differentiate between King and Silver Salmon Juveniles in Alaska. Alaska Department of Fish and Game, Informational Leaflet No. 1, 6 pp.

Neuhold, J.M, and K.H. Lu. 1957. Creel Census Method. Utah Department of Fish and Game, Publication No. 8, 36 pp.

Prepared by:

Larry J. Engel
Fishery Biologist

Date: April 30, 1968

Approved by:

s/ Louis S. Bandirola
D-J Coordinator

s/ Alex H. McRea, Director
Sport Fish Division